Available Post-Grad Projects

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Mulloon Institute
For environment, farming and society

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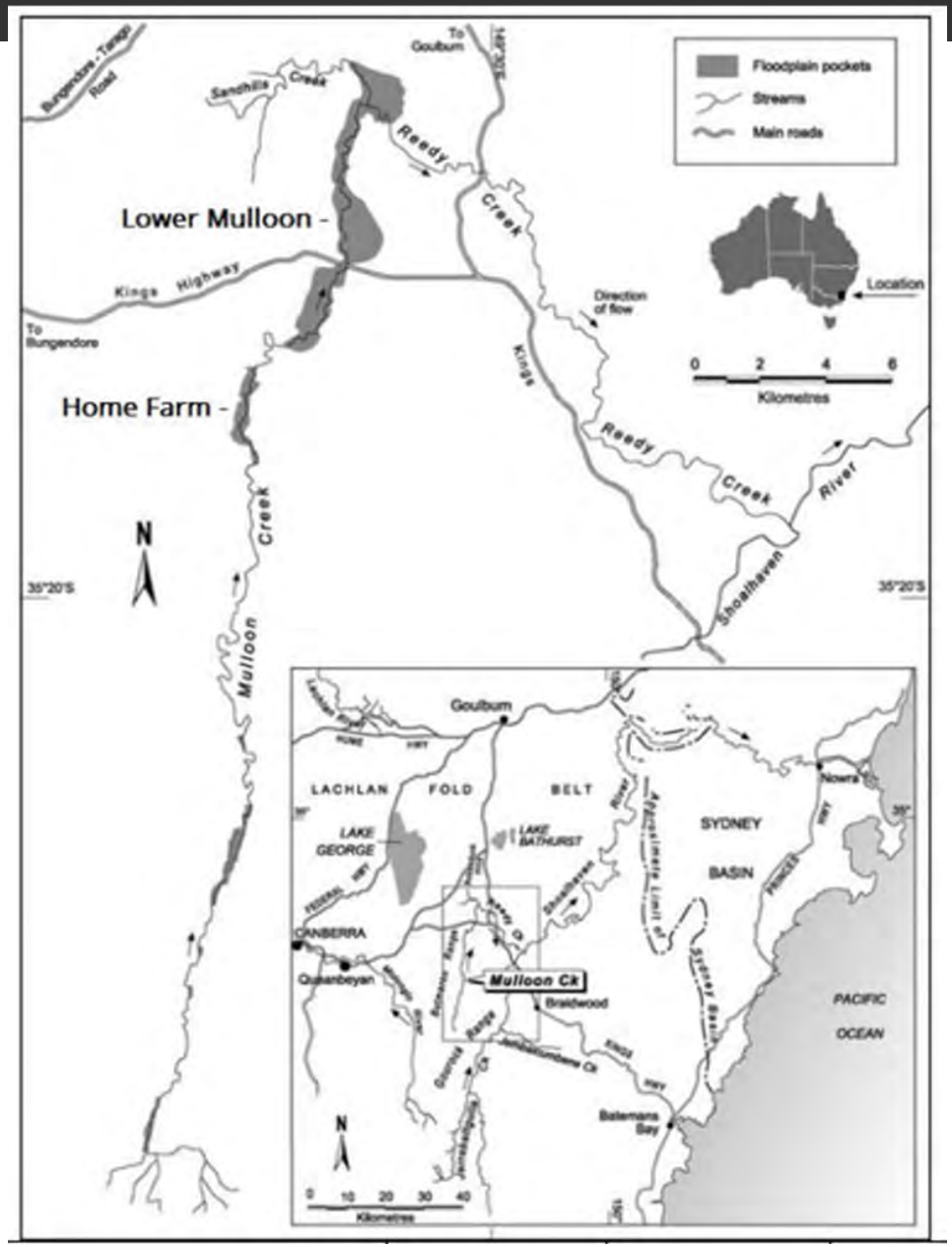
- 23,000 Ha
- 50km of waterway rehabilitation
- 20+ Landholders
- Significant investment in monitoring
- Baseline surveys already completed
- <1hr from ANU



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Four Main Themes

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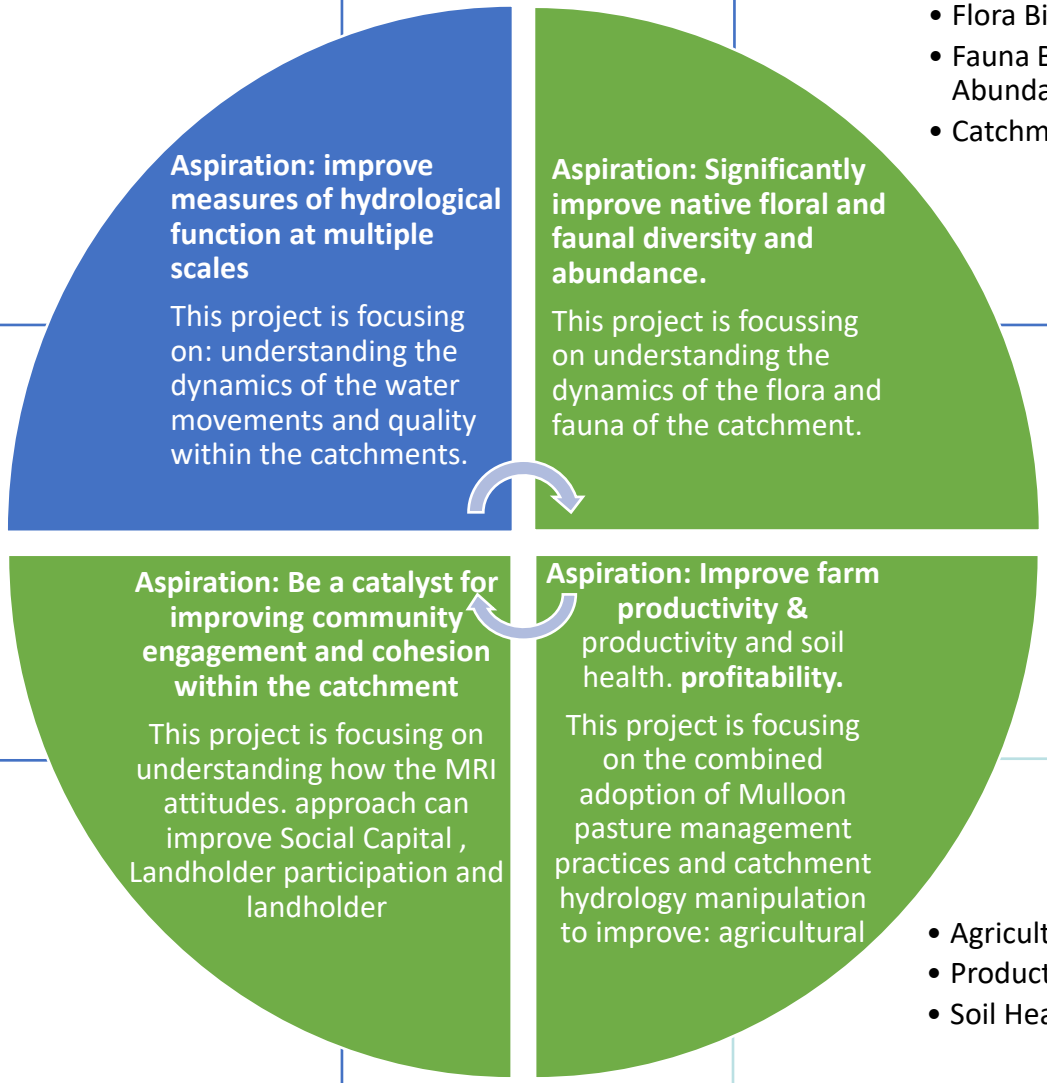
1. Productivity – farm and natural capital, including soil health
2. Hydrological – surface & sub-surface water balance & quality
3. Ecological Function – diversity & abundance
4. Social Capital – people, adapting to change and adopting new methods

- Hydrological Function
- Water Balance
- Water Quality

- Ecology
- Flora Biodiversity
- Fauna Biodiversity & Abundance.
- Catchment Health.



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- Social Capital

- Agricultural
- Productivity
- Soil Health

Broad Hypotheses

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H1 – Significantly improve native floral and faunal diversity and abundance

H2 – Significantly improve measures of hydrological function at multiple scales

H3 – Be a catalyst for significant improvements in measures of farm productivity and profitability.

Example Projects

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- Water Balance Model APSIM SoilWAT
- Assess landscape repair processes of implementing brushpacks
- Assess vegetation cover and biomass response on-ground and satellite data (LFA, RARC)
- Assess soil water availability or physio-chemical attributes
- Assess water storage and quality in groundwater and or surface waters, and/or modelling of either
- Various fauna surveys – birds, frogs, aquatic macroinvertebrates, soil biology
- More details in following slides

Projects can be at various scales

- Catchment
- Property
- Subset Management Areas;
  - Alluvial channel
  - Riparian corridor
  - Alluvial Plain

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Significant Investment in Automated Monitoring Equipment

Sophisticated data management system DataStream portal with partner HydroTerra

HydroTerra
Environmental Monitoring Specialists

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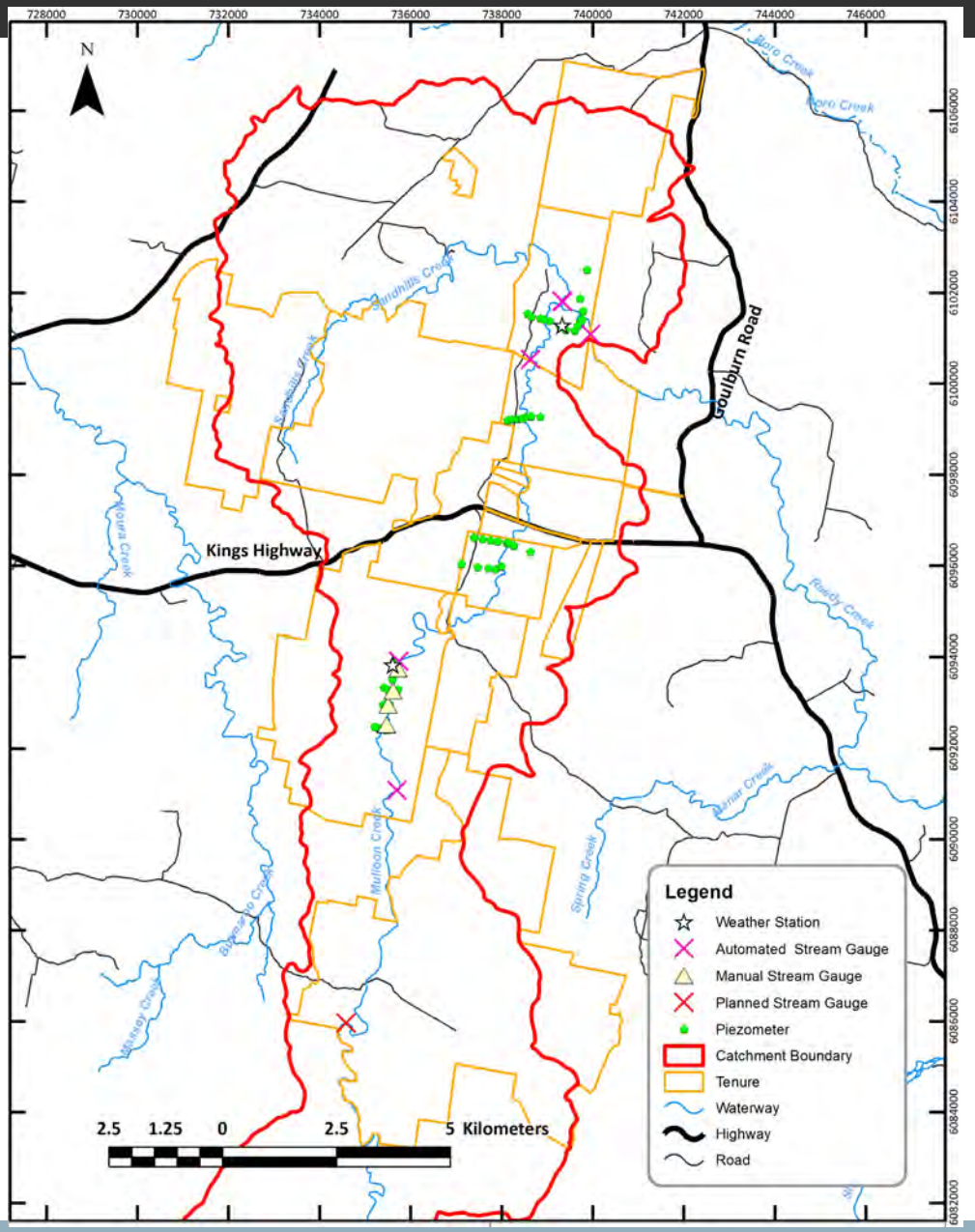


Management Area – Alluvial Channel

- Surface water quantity (level and or storage), quality, flow rates, discharge using data from automated stream gauges and manual measurements
- Rapid stream assessment (manual) – previous data and reports
- Aquatic macroinvertebrates – 2 surveys completed by Dr Paul Cooper (ANU)
- Fish surveys – conducted by Uni Canberra

Management Area – Riparian Corridor

- Rapid Appraisal Riparian Condition (RARC) – baseline completed
- Bird Surveys – data collected by Damon Oliver NSW OEH further surveys and data analysis & reporting
- Frog surveys – two conducted (2017 & 20)
- Fish surveys – conducted by Uni Canberra

Management Area – Floodplain

- Groundwater sensors
  - Analyse levels and storage, quality, connectivity with stream, multiple aquifers (shallow and deep)
- Soil Moisture sensors
  - Analyse for plant available water, volumetric water content, capacity, drainage upper limit
  - Require calibration with soil physical parameters eg bulk density
- Salinity in soil and deeper regolith

Management Area – Floodplain

- Modelling water balance APSIM SoilWAT
  - Extensive climate station data in combination with water monitoring data
- Extent and duration of flood events
- Productivity of different management systems
  - Biomass sampling (manual and or plate meter)
  - Calibration of satellite data (CIBO Labs) and generate spatial analysis from point source

Management Area – Floodplain

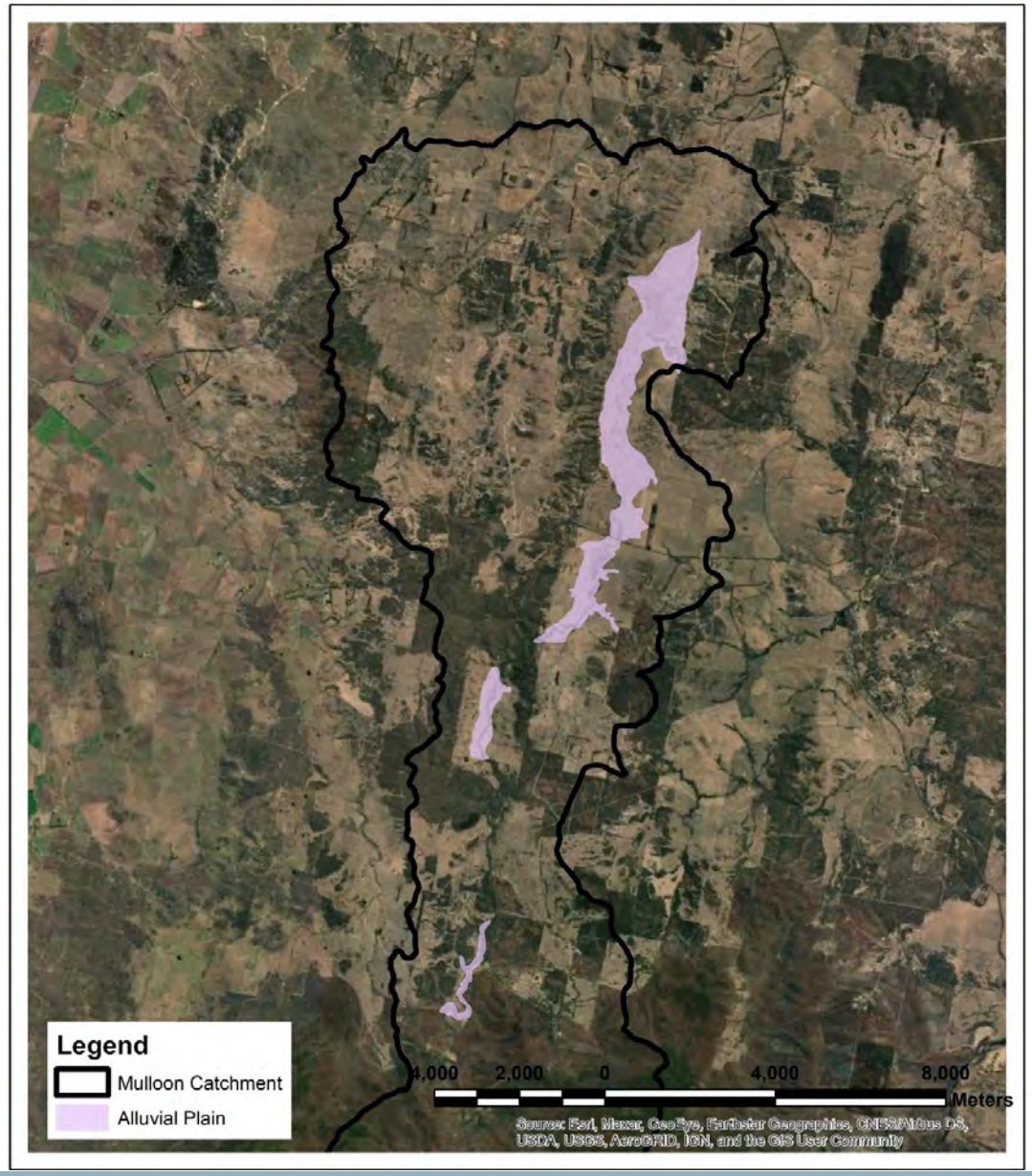
- Landscape Function Analysis (LFA)
  - Established sites across catchment in floodplains and across the catena sequence
  - Brushpack assessment from previous ANU Fenner School students
  - Analyse spatial and temporal effect with satellite data

Management Area – Floodplain

- Soils Analysis
  - Chemical parameters ie soil organic matter, salinity (initial study conducted)
  - Physical attributes ie bulk density, composition
  - Biological attributes ie soil biota, fungi
  - Infiltrometer at various sites including LFA or other landscape interventions ie contours, brushpacks
  - Previous projects ANU Fenner School

Satellite Analysis – CIBO Labs

- Spatial and temporal analysis of
  - Pasture cover
  - Pasture greenness and growing period (ie has it been extended)
  - Woody cover change
  - Assessment of satellite derived outputs indicating biomass and food on offer (FOO)
  - Link with RARC or LFA datasets



Management Area 1

- Alluvial Floodplain

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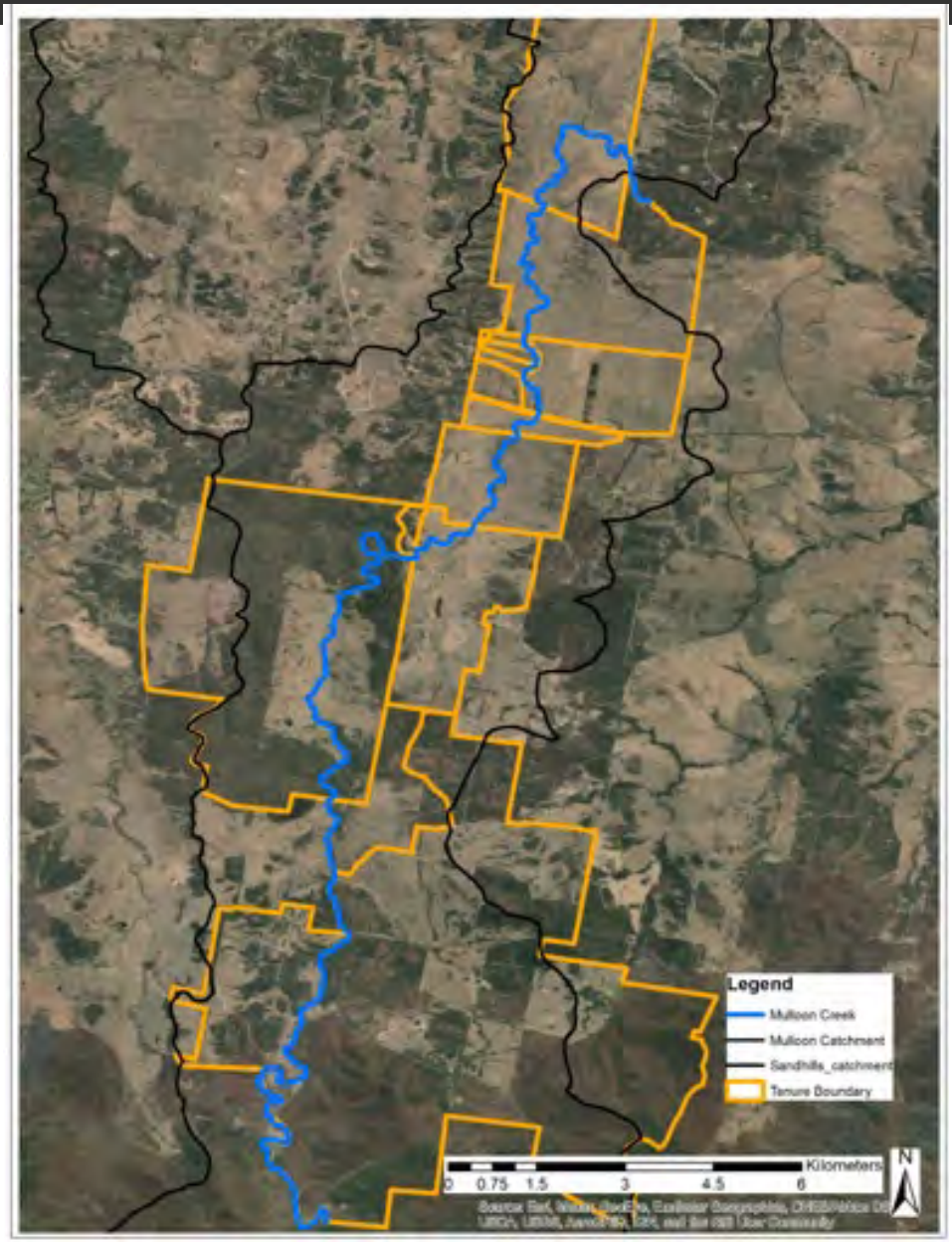

Management Areas 2 & 3

- Alluvial Channel
- Riparian Zone

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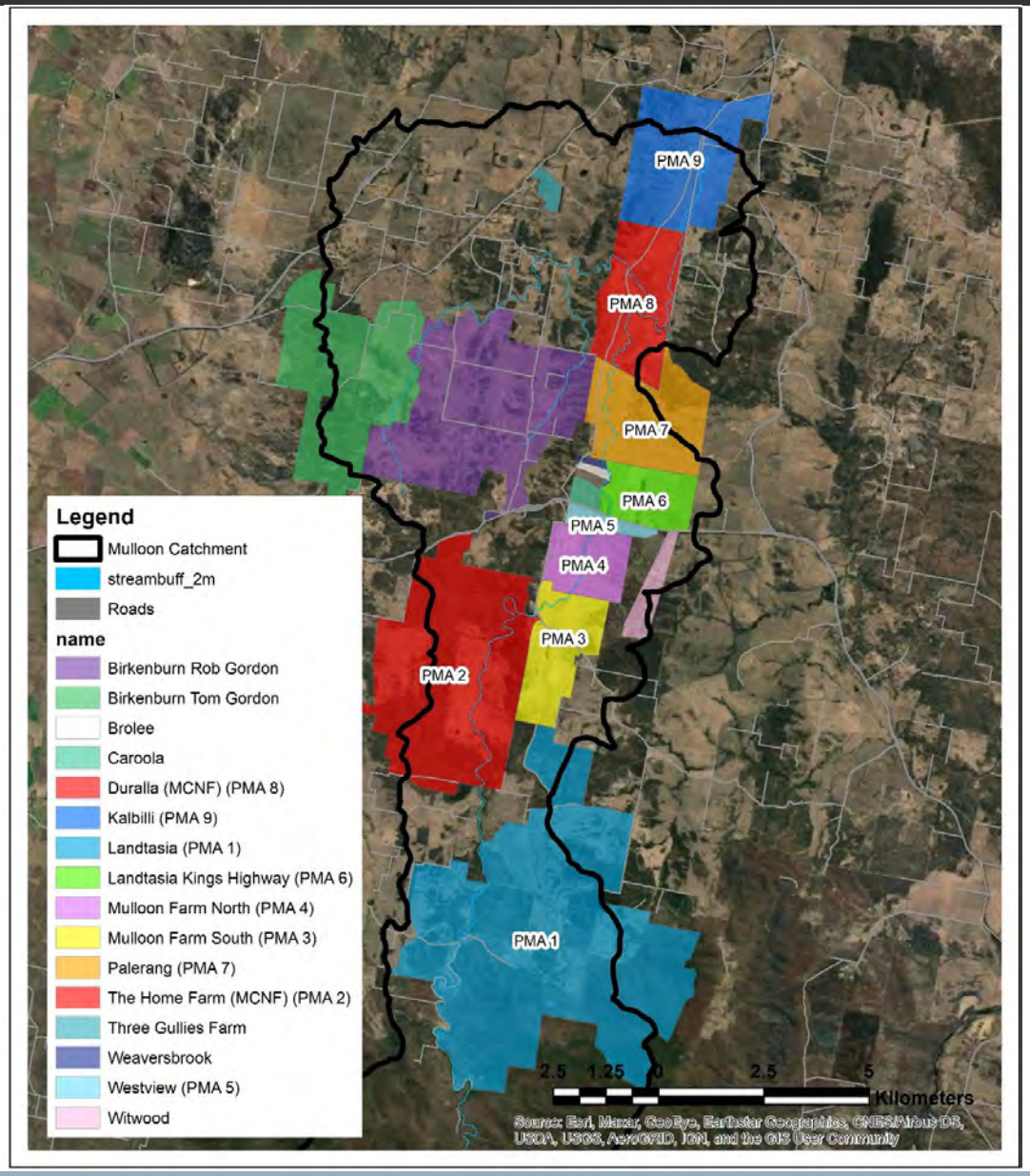

Property Management Areas

TMI bequeathed properties in red

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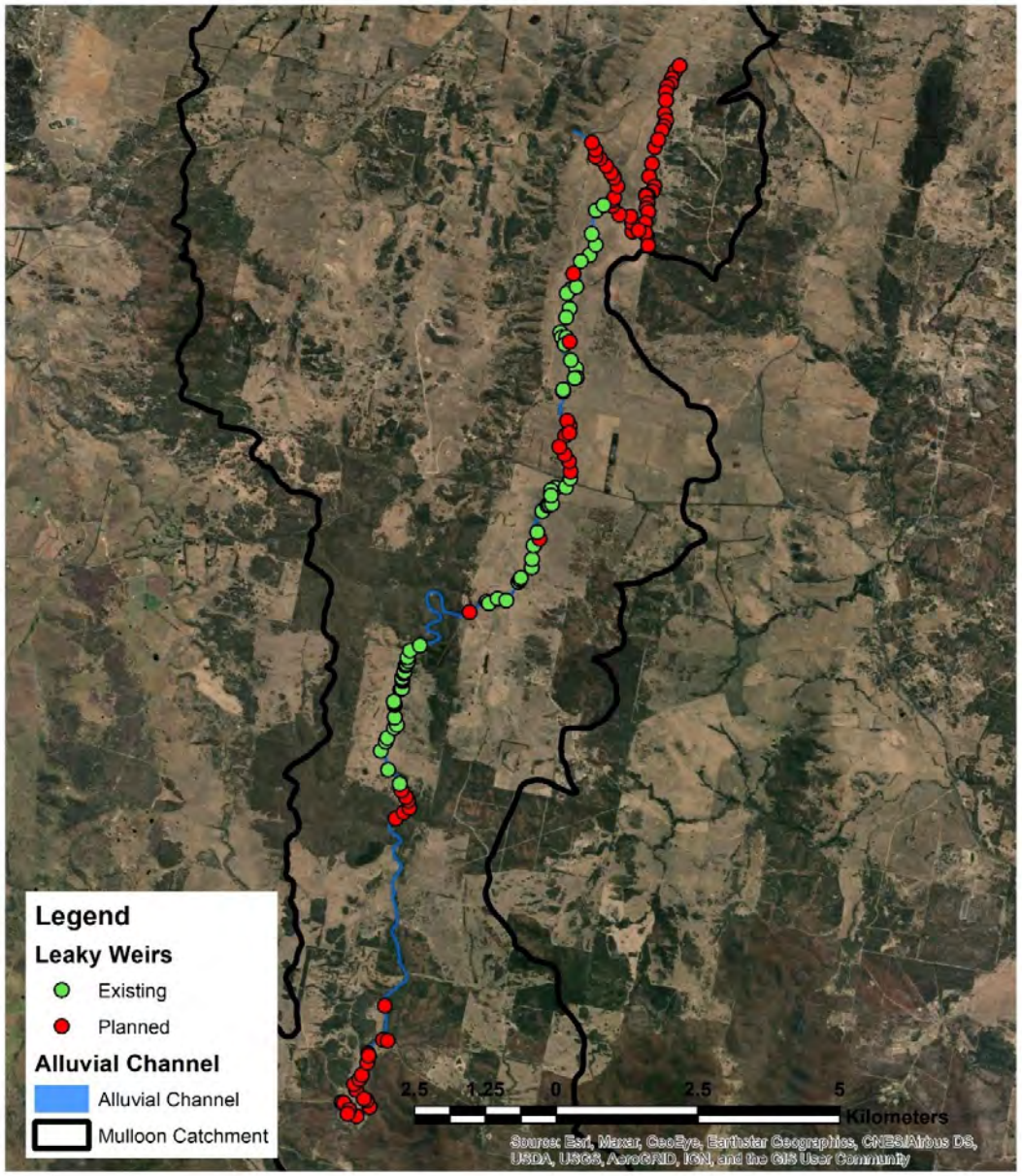

Management Area 2

- Alluvial Channel with interventions of streambed erosion control structures leaky weirs

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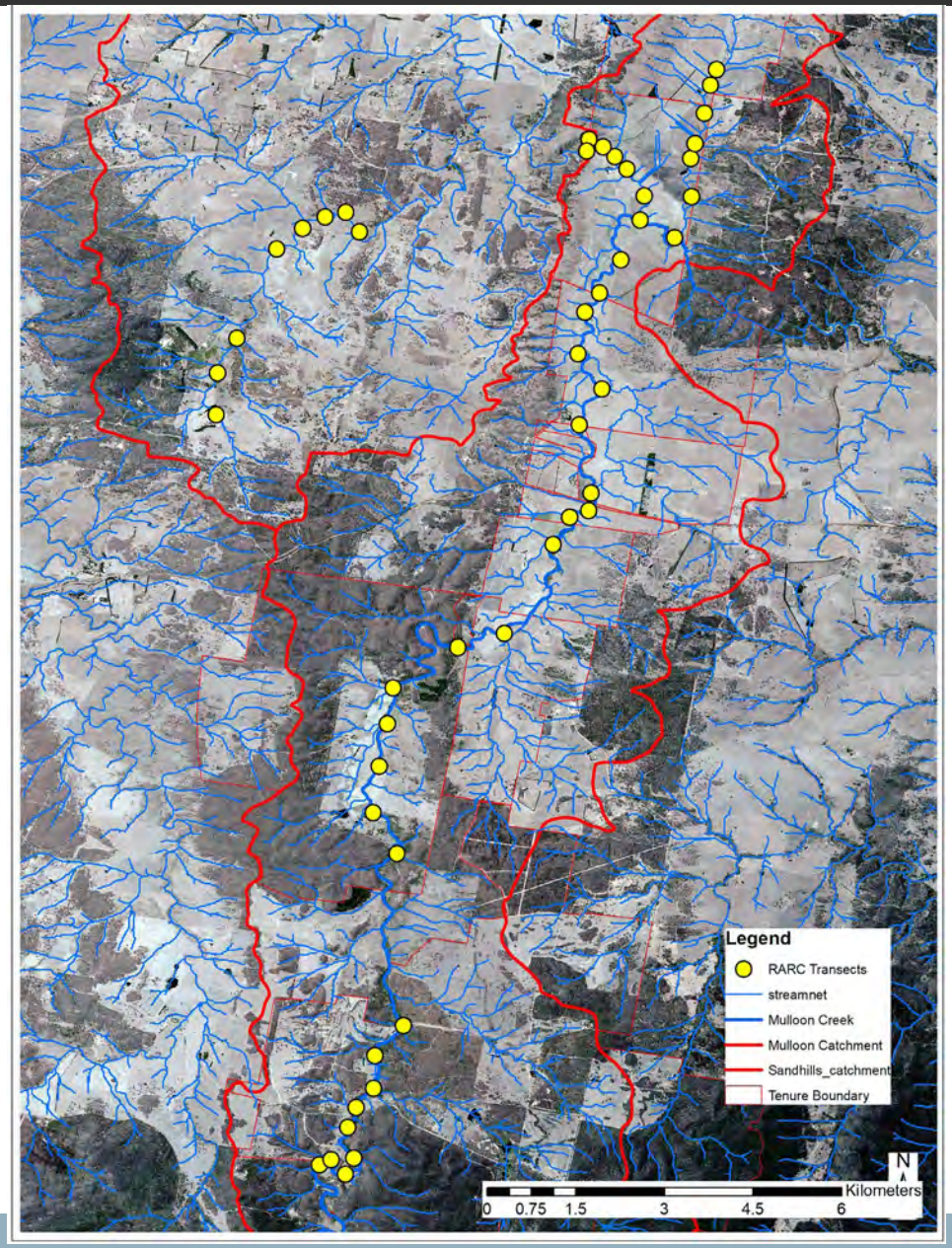

Management Area 3

- Rapid Appraisal Riparian Condition assessment of sites building on existing datasets
- Assess what other parameters would be useful

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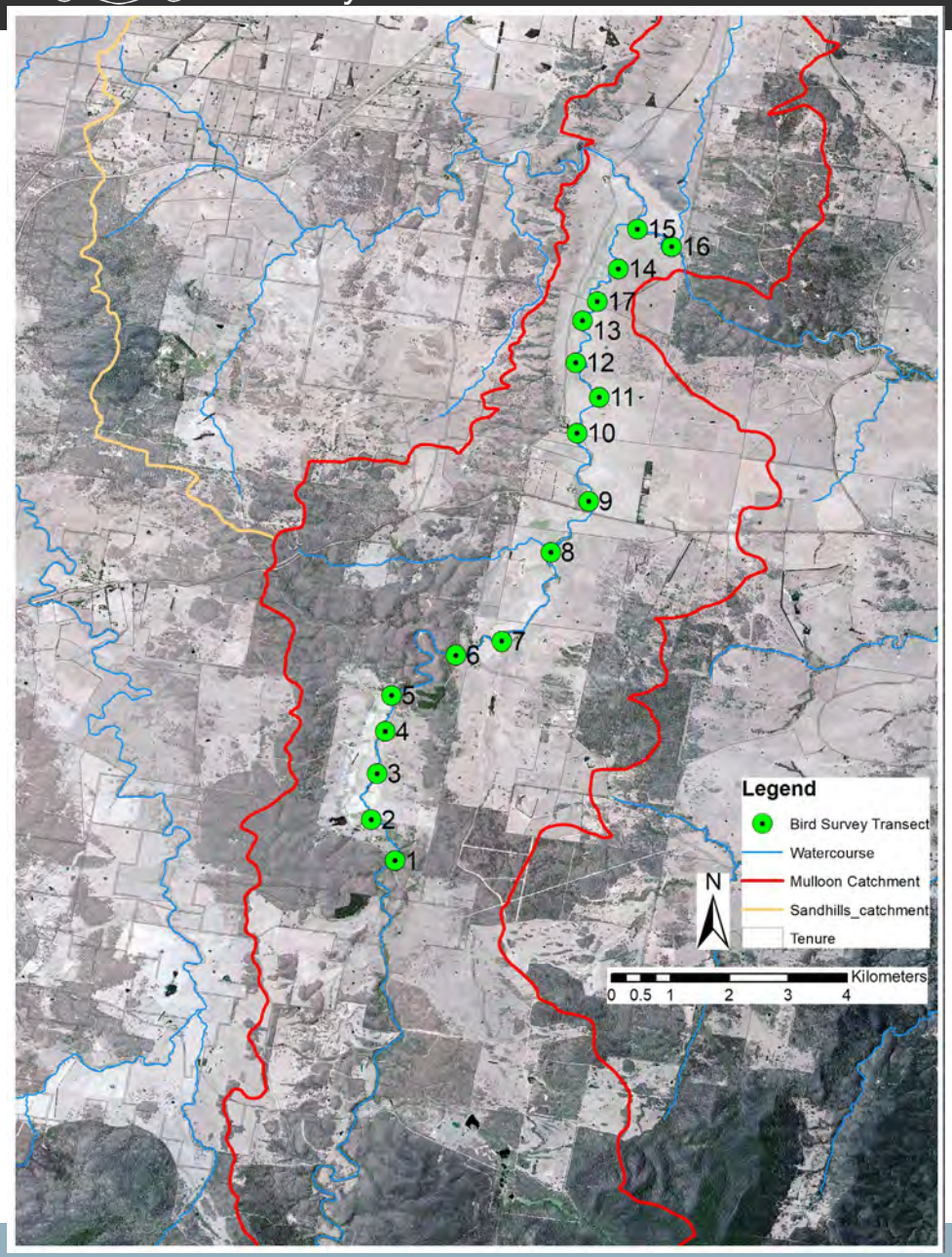

Management Area 3

- Bird survey transects building on existing datasets
- Potential to expand to surrounding grasslands and woodlands

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Research Opportunity LFA

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The Problem

- Rehabilitation of degraded soil surfaces

Solution

- The value of brush packs for restoring landscape function

Research Opportunity LFA

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Quantify the landscape benefits of brushpacks

Largest brushpack in Australia: Est Sept 2020 by Fenner Enviro Field School students

Research Opportunity LFA

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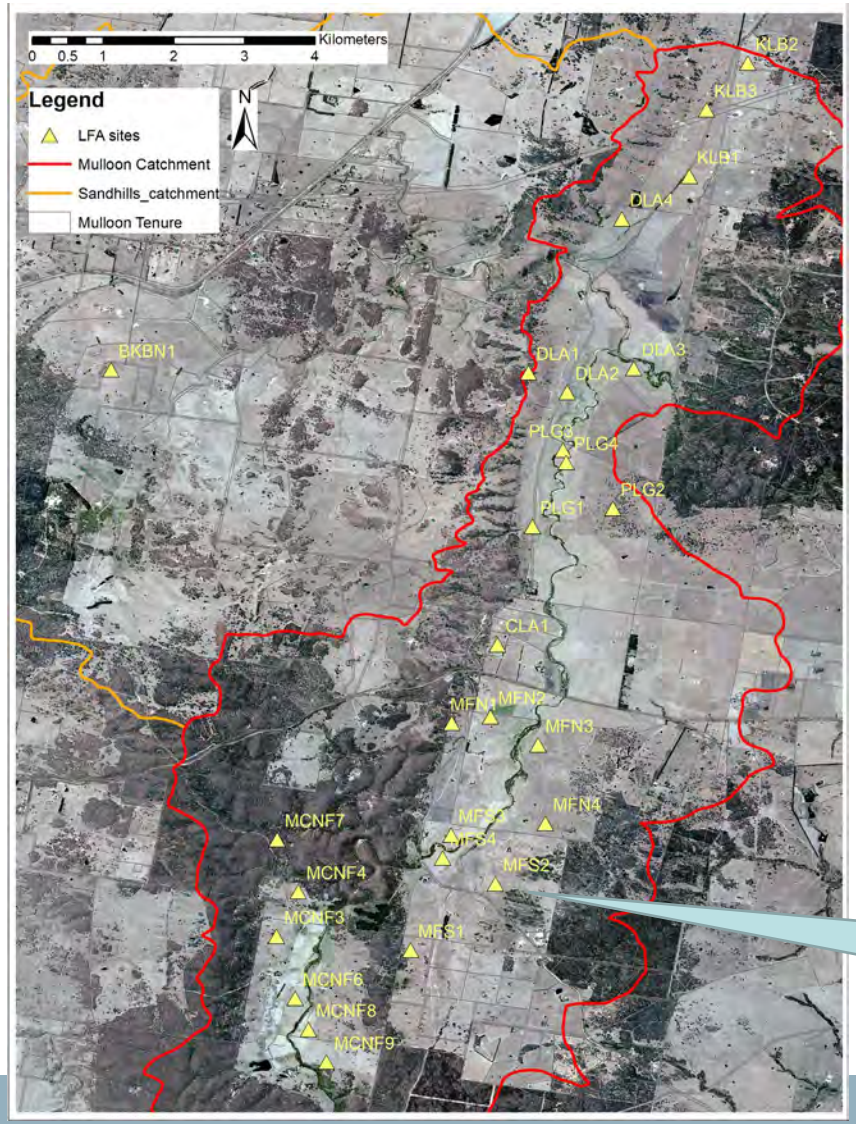

- Quantify landscape response to rehydration works and land management.
- Assess temporal and spatial response with satellite data

Brushpack LFA sites

Research Opportunity

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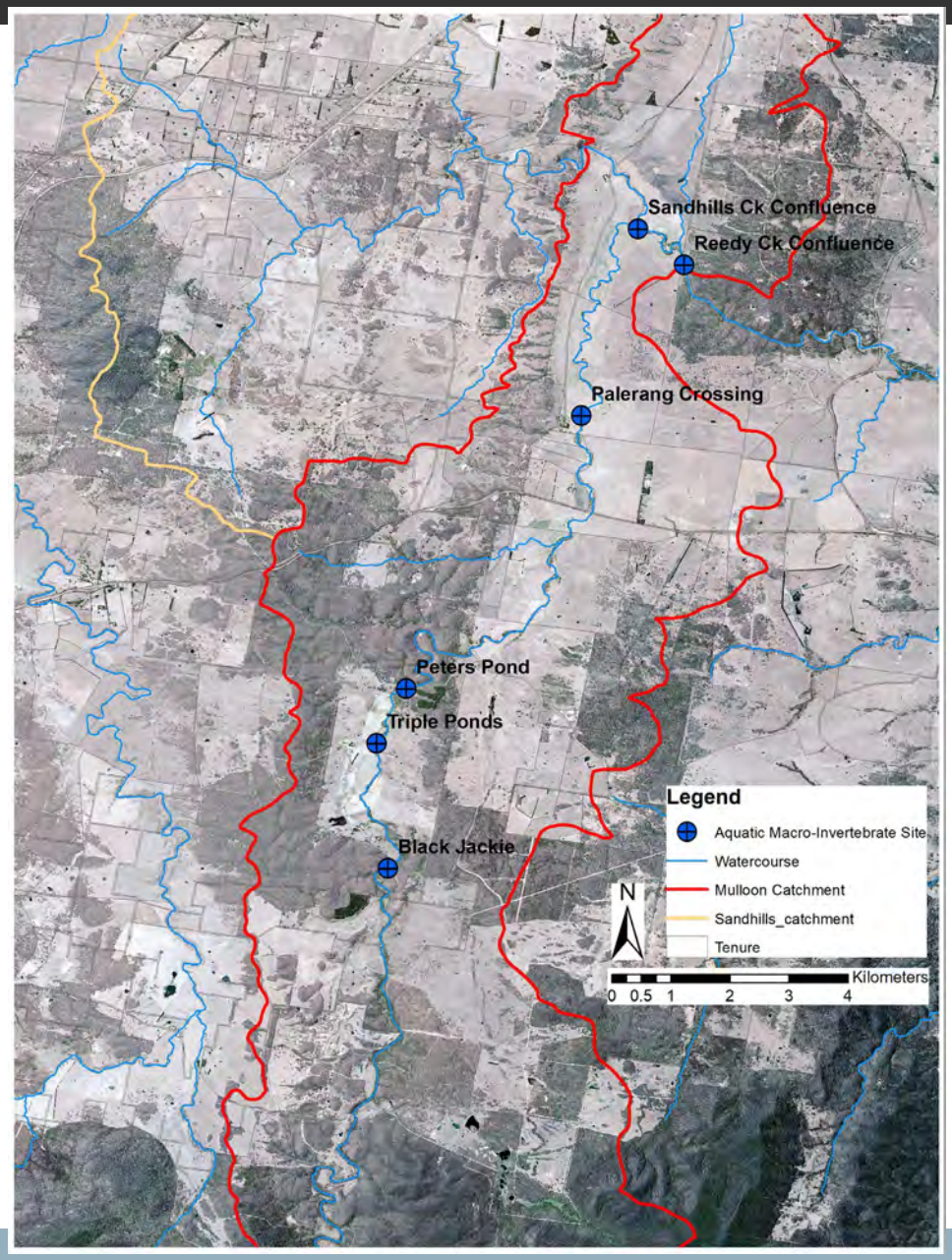
Using macroinvertebrates to determine water quality in the Mulloon Creek catchment

- Build onto previous surveys carried out in 2015-16 and 2018-19 to determine how water quality has changed with various projects
- Assess physic-chemical characterisation of the water and compare those measurements with the macroinvertebrates that are present to develop an understanding of how the environmental conditions can affect an invertebrate community
- Dr Paul Cooper Luke Peel Peter Hazell

Find out more here



Management Area 2

- Aquatic macro invertebrate monitoring sites

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Research Opportunity

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Table of Water Balance Modelling Virtual Variables

Proposed use of APSIM SoilWAT Water Balance to model the water balance of the Alluvial Plain

Name	Units	Description
Es	mm	Daily soil evaporation
Eo	mm	Daily potential evapotranspiration
Eos	mm	Daily potential soil evaporation
cn2_new		Daily value CN2 adjusted for surface cover
Runoff	mm	Daily runoff
Drain	mm	Daily drainage from bottom of soil profile
infiltration	mm	Daily infiltration across the soil surface
eff_rain	mm	Effective Rainfall (Rainfall – Runoff – Drainage).
salb		Bare soil albedo
bd	g/cm^3	Bulk density of the soil for each layer
esw	mm	Extractable soil water in each layer (ie. sw_dep – ll15_dep)
sw_dep	mm	Amount of water in each layer
sw	mm^3/mm^3	Volumetric water content in each layer
dlayer	mm	Thickness of each soil layer
ll15_dep	mm	Amount of water corresponding to a soil potential of 15 bar
ll15	mm^3/mm^3	Volumetric water content for each layer corresponding to a soil potential of 15 bar
dul_dep	mm	Amount of water at drained upper limit for each soil layer
dul	mm^3/mm^3	Volumetric water content at drained upper limit for each soil layer
sat_dep	mm	Amount of water in each layer at saturation
sat	mm^3/mm^3	Volumetric water content at saturation for each soil layer
air_dry_dep	mm	Amount of water retained at air_dry for each layer
air_dry	mm^3/mm^3	Volumetric water content for air dry soil in each layer
flux	mm	Saturated water flux from each layer to the layer below
flow	mm	Unsaturated water movement between layers (+ve up)
flow_nnnn	kg/ha	Amount of solute nnnn in saturated water movement from each layer to the layer below (where 'nnnn' is the name of the solute)(eg. flow_no3)
water_table	mm	Depth of the water table (10000 if no water table present)
pond	mm	Surface ponding
outflow_lat	mm	Lateral outflow from each layer

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Table of Water Balance Weather Variables collected at 2 stations

Name	Supplier Parameter Name	Units	Description
RAIN-9AM-1	Rainfall Since 9am	mm	Precipitation since 9am
TEMP-1	Air Temperature	°C	Air temperature
RH-1	Relative Humidity	%	Relative Humidity
DEW-1	Dew Point	°C	Dew Point
EVAP-1	Evaporation Rate	mm/h	Evaporation Rate
SOL-IN-1	Incoming Solar Radiation	W/m2	Incoming Solar Radiation
SOL-OUT-1	Outgoing Radiation	W/m2	Outgoing Solar Radiation
SOIL-HFLX-1	Soil Heat Flux	W/m2	Soil Heat Flux
SOIL-TEMP-10CM-1	Soil Temp 10cm	°C	Soil Temperature 10 cm
SOIL-TEMP-20CM-1	Soil Temp 20cm	°C	Soil Temperature 20 cm
SOIL-TEMP-30CM-1	Soil Temp 30cm	°C	Soil Temperature 30 cm
SOIL-TEMP-40CM-1	Soil Temp 40cm	°C	Soil Temperature 40 cm
SOIL-TEMP-HD-1	Soil Temp HD	°C	Soil Temperature HD
PK-WND-GUST-1	Peak Wind Gust	km/h	Peak Wind Gust
V-WND-DIR-1	Vector Wind Direction	NESW	Vector Wind Direction
V-WND-SPD-1	Vector Wind Speed	km/h	Vector Wind Speed
WND-DIR-1	Wind Direction	NESW	Wind Direction
WND-SPD-1	Wind Speed	km/h	Wind Speed
BARO-1	Barometric Pressure	hPa	Barometric Pressure
SOIL-VWC-10CM-1	Soil Moisture 10cm	VWC%	Soil Volumetric Water Content 10 cm
SOIL-VWC-20CM-1	Soil Moisture 20cm	VWC%	Soil Volumetric Water Content 20 cm
SOIL-VWC-30CM-1	Soil Moisture 30cm	VWC%	Soil Volumetric Water Content 30 cm
SOIL-VWC-40CM-1	Soil Moisture 40cm	VWC%	Soil Volumetric Water Content 40 cm